(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 978 250 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
09.02.2000 Bulletin 2000/06

(51) Int. Cl.[7]: **A47L 15/48**

(21) Application number: **99115218.2**

(22) Date of filing: **02.08.1999**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **06.08.1998 IT TO980686**

(71) Applicant: **Bitron S.p.A.**
10064 Pinerolo(Torino) (IT)

(72) Inventors:
- **De Filippis, Pietro**
  20052 Monza (MI) (IT)
- **Maggi, Flavio**
  20132 Milano (IT)

(74) Representative:
Lotti, Giorgio et al
c/o Ing. Barzanò & Zanardo Milano S.p.A.
Corso Vittorio Emanuele II, 61
10128 Torino (IT)

(54) A device for drying the dishes at the end of the washing process of a dishwasher

(57) A device (1) for drying the dishes at the end of the washing process of a dishwasher (10), said device (1) has a condensing duct (11) connected, at its inlet and outlet sections, to the washing tank (12) of the dishwasher (10), an electric fan (13) positioned within the duct (11) at an outlet (11u) of said duct (11) in order to make an air-steam mixture (14) advance along the duct (11), and a heat exchange surface (15s) positioned within the duct (11), and maintained at a temperature substantially lower than the dew point temperature of the mixture (14).

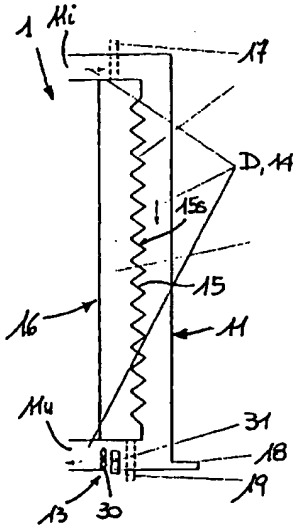

Fig. 2

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Description

[0001] The present invention refers to a device for drying the dishes at the end of the washing process of a dishwasher.

[0002] At the end of the washing process of a dishwasher, in order to dry the dishes, it is necessary to evaporate the water left on said dishes, and it is necessary that the following conditions are met:

a) the air within the dishwasher must have a steam content lower than the saturation level;
b) the water on the dishes must have a temperature higher than the dew point temperature of the air.

[0003] Therefrom, the need to reduce the steam content of the air or to heat the air or to substitute the air contained in the dishwasher with other air having a lower steam content.

[0004] In order to condense the steam contained in the air, said steam has to transfer heat to a body at a temperature lower than the dew point temperature of the air-steam mixture.

[0005] Some manufacturers use electric resistors to heat the air inside the dishwasher and therefore to lower the relative humidity, in order to enhance the drying process.

[0006] The disadvantage of said process is the significant consumption of electric energy. Then, the normal heat dissipation towards the outside environment causes the decrease of the temperature of the tank walls and the condensing of the steam on said walls.

[0007] Other manufacturers use fans to draw the steam from the dishwasher and to send it into the outside environment; the so expelled air-steam mixture is substituted with outside air which contains dust which can dirty the dishes.

[0008] Another disadvantage of this process is the introduction of steam and of odours into the environment.

[0009] Further, this type of process is not suitable with the integral built-in dishwashers in the kitchen furniture.

[0010] Other manufacturers use cold water in order to cool one or more inside walls of the dishwasher whereon the steam can condense; this solution has the advantage that it does not consume any amount of energy, but the lack of ventilation obstructs the water evaporation from the dishes, since the air moves only because of weak convective movements caused by the different temperatures on the various tank walls.

[0011] The purpose of the present invention is to realise a device to enhance the drying process of the dishes at the end of the washing process of a dishwasher, said device being free from the above described disadvantages.

[0012] According to the present invention, a device for drying the dishes at the end of the washing process of a dishwasher is realised, said device is characterised by comprising a condensing duct connected, at its inlet and outlet sections, to the washing tank of the dishwasher, a forced conduction device of an air-steam mixture along said duct, and heat exchange means positioned along the duct, and maintained at a temperature substantially lower than the dew point temperature of said mixture.

[0013] The invention will now be described making reference to the attached drawings, which describe a non limiting example of an embodiment, wherein:

- figure 1 shows, in a schematic way, a dishwasher provided with a first preferred embodiment of the device according to the invention;
- figure 2 is a schematic side elevation view of the device of figure 1;
- figure 3 is a schematic side elevation view of a second preferred embodiment of the device of figure 1;
- figure 4 is a front view of a third type of embodiment of the device of figure 1, said view has sectional views of some of the parts and some exploded parts for clarity sake;
- figure 5 is an enlarged perspective view, with some exploded parts for clarity sake, of a detail of figure 4; and
- figure 6 is a side elevation view of the device of figure 4, said view has sectional views of some of the parts and some exploded parts for clarity sake.

[0014] Referring to figure 1, numeral 1 indicates, as a whole, a device for drying the dishes at the end of the washing process of a dishwasher 10.

[0015] The device 1 comprises a condensing duct 11 which extends outside a dish washing tank 12, and said duct is fully positioned inside the dishwasher 10, and an electric fan 13 suitable to feed an air-steam mixture 14 along said duct 11.

[0016] The duct 11 comprises an inlet 11i and an outlet 11u directly connected to the tank 12, while the electric fan comprises a fan 30 positioned within the duct 11, substantially at the outlet 11u or along said duct 11, and a driving motor 31 suitable to rotate the fan 30 so as to draw the mixture 14 from the tank 12 and to make said mixture advance in a feed direction D along said duct 11.

[0017] The device 1 further comprises a water tank 16, which is suitable to be filled with a certain amount of water at the beginning of the drying process, and which is provided with a heat exchange wall 15 positioned inside the duct 11, and maintained at a temperature lower than the dew point temperature of the air by said water. The heat exchange between the mixture 14, which circulates inside the duct 11, and the wall 15 causes the condensing of at least a portion of the steam of said mixture 14.

[0018] The size of said tank 16 is a function of the amount of steam which needs to be condensed; in fact, since the device 1 is a closed device, i.e. a device which

does not have any outside emissions, said device works by using the water thermal capacity in order to accumulate the steam condensing energy.

[0019] If the overall dimensions do not allow a sufficient water capacity, it is possible to divide the drying process by changing one or more times the warmed up water load of the tank 16 with cool water.

[0020] In order to enhance the heat exchange, the wall 15 has a sufficiently reduced thickness, while the corresponding exchange surface 15s which faces the inside of the duct 11 has an elevated exchange area. In the non limiting example of embodiment shown in figure 2, the surface 15s has a bellows-like shape, but it can have any other shape and it can be realised with any kind of material.

[0021] As an alternative to water, the tank 16 can contain other materials as, for instance, waxes, paraffin, some phosphate salts, PCM (*Phase Change Material*), which allow to accumulate heat through physical changes or through endothermic chemical reactions.

[0022] No replacement is provided for these materials inside the tank 16, and the heat accumulated in said materials to maintain the wall 15 at a temperature lower than the dew point temperature of the air is transferred to the outside environment during the rest period of the dishwasher 10 between the washing cycles, and, in order to enhance the heat exchange between the outside environment and the tank 16, the latter can be installed, for instance, in an opening (not shown) of the dishwasher 10.

[0023] Further, the device 1 comprises a feed opening 17 to feed cool water to the tank 16, and a discharge opening 19 to discharge the heated water from said tank 16; while the duct 11 is provided with a discharge outlet 18 for the condensate, which is collected by the gravity force from the surface 15s at said discharge outlet 18.

[0024] The discharge outlet 18 is connected alternatively to a small well (not shown) in the dishwasher 10, or directly to the tank 12, and, in this case, in order to avoid flooding the duct 11 with the washing water, the discharge outlet 18 is provided with a stop solenoid valve (not shown and of a known type), or with a float (not shown and of a known type) suitable to automatically close said discharge outlet 18.

[0025] According to what is shown in figure 3, the tank 16 could also be defined by a bag 20 hermetically sealed placed inside the duct 11 and which is not in contact with said duct 11 so as to have its outer surface 15s fully surrounded by the mixture 14.

[0026] Because of the partial condensing of the steam, the air-steam mixture at the outlet 11u of the condensing duct 11 has a lower steam content with respect to the inlet conditions into said duct 11.

[0027] The position of the electric fan 13 used to circulate the air is also important, in fact, by placing the electric fan 13 at the outlet 11u of the condensing duct 11, it is possible to maintain the pressure inside said duct 11 at a value lower than the value of the environment pressure because of the normal pressure drops inside the ducts: this fact further enhances the condensing since the pressure value influences the saturation temperature. Further, by placing also the motor 31 inside the duct 11 and by making the air, before it goes back into the tank 12 of the dishwasher 10, get in touch and cool said motor 31, a partial heating of the air itself is obtained with a consequent further decrease of the relative humidity. The power dissipated by the motor 31 is therefore used to further enhance the drying process.

[0028] However, the electric fan 13 can be placed at any point of the duct 11, according to the production needs, without, for this reason, significantly jeopardising the just described advantages with respect to the positioning of said electric fan 13 at the outlet 11u.

[0029] Figures 4, 5 and 6 show a preferred embodiment of the device 1, wherein, for reasons of overall dimensions, the duct 11 is mounted laterally and below the tank 12, and the electric fan 13 is placed inside the duct 11 and directly below the tank 12.

[0030] In particular, in order to avoid at the same time that the washing water floods the duct 11, the inlet 11i is provided with a vertical siphon 51, while the outlet 11u is provided with a corresponding vertical siphon 52, which is positioned on the same plane of the siphon 51 and the mixture 14 passes vertically through said siphon 52 to reduce its speed and to enhance the heat exchange with the wall 15, which defines a rear wall both for the siphon 51 and for the siphon 52.

[0031] The fact that the two siphons 51 and 52 are integral with the wall 15 allows to take the best advantage of the available room by reducing to the minimum requirements the overall dimensions of the device 1.

[0032] At least the fan 30 of the electric fan 31 is enclosed in a fluid tight box 53, which defines an intermediate portion of the duct 11, and it is positioned below the tank 12, and it comprises an elbow shaped inlet 53i connected to the siphon 52 in order to fully insulate said electric fan 13 from the tank 12.

[0033] Said box comprises two side appendices, wherein the appendix 54 defines an elbow shaped inlet duct for the siphon 51, while the appendix 55 has an inlet duct 56 and an outlet duct 57 of the water from the tank 16. In particular, the siphon 51 is substantially U-shaped and has its concave portion facing downward, while the siphon 52 has substantially an upside-down L shape and extends from the outlet 53u until it reaches the outlet 11u, and it is provided with a plurality of inner bent tiles 58 suitable to obstruct the free flow of the mixture 14.

[0034] In the example of embodiment shown in figures 4, 5 and 6, the fan 30 is a fan which has an axial inlet flow and a radial outlet flow in order to feed both the outlet 53u and the appendix 54 so as to enhance the circulation of the mixture 14 along the duct 11.

[0035] It is understood that the invention is not limited by the herein described and shown embodiments,

which have to be considered as realisation examples of the device 1 for the drying process of the dishes, which is instead suitable for further changes with respect to part shapes and to part positioning, and to production and assembly details.

Claims

1. A device for drying the dishes at the end of the washing process of a dishwasher (10), said device (1) is characterised by comprising a condensing duct (11) connected, at its inlet and outlet sections, to the washing tank (12) of the dishwasher (10), a forced conduction device (13) of an air-steam mixture (14) along said duct (10), and heat exchange means (15) positioned along the duct (11), wherein said heat exchange means are maintained at a temperature substantially lower than the dew point temperature of said mixture (14).

2. A device as claimed in claim 1, characterised in that said fan (30) is positioned inside the duct (11).

3. A device as claimed in claim 1 or 2, characterised in that said forced conduction device (13) comprises a fan (30) positioned substantially at one outlet (11u) of said duct (11).

4. A device as claimed in claim 1 or 2, characterised in that the duct (11) comprises an intermediate portion (53) positioned below said tank (12); said fan (30) is positioned inside said intermediate portion (53).

5. A device as claimed in claim 2 or 3, characterised in that said forced conduction device (13) comprises a motor (30) to drive said fan (31), the motor (30) is positioned inside said duct (11) substantially at said outlet (11u).

6. A device as claimed in claim 4 or 5, characterised in that said device (13) comprises at least a siphon (51) integral with said device (13) positioned at said inlet (11i).

7. A device as claimed in any of the previous claims, characterised in that said heat exchange means (15) comprise an exchange surface (15s) fully positioned inside the duct (11), and cooling means (16)(20) of said exchange surface (15s) in order to maintain the exchange surface (15s) at a temperature lower than the dew point temperature of said mixture (14).

8. A device as claimed in claim 7, characterised in that said cooling means (16)(20) are defined by a tank (16)(20) suitable to receive, at the beginning of each drying process, a certain amount of cooling fluid; said exchange surface (15s) is an outer wall of said tank (16)(20).

9. A device as claimed in claim 7, characterised in that said cooling means (16)(20) are defined by a tank (16)(20) which contains a defined amount of cooling fluid; said exchange surface (15s) is an outer wall of said tank (16)(20).

10. A device as claimed in claim 8, characterised in that said tank (20) is defined by an envelope (20) fully positioned inside said duct (11) in a position detached from said duct (11).

11. A device as claimed in any of the previous claims, characterised in that said duct (11) comprises a discharge outlet (18) to expel the condensed steam from said duct (11).

12. A device as claimed in any of the previous claims, characterised in that said duct (11) is fully positioned inside said dishwasher (10).

13. A device for drying the dishes at the end of the washing process of a dishwasher, substantially as it has been described with reference to any of the attached drawings.

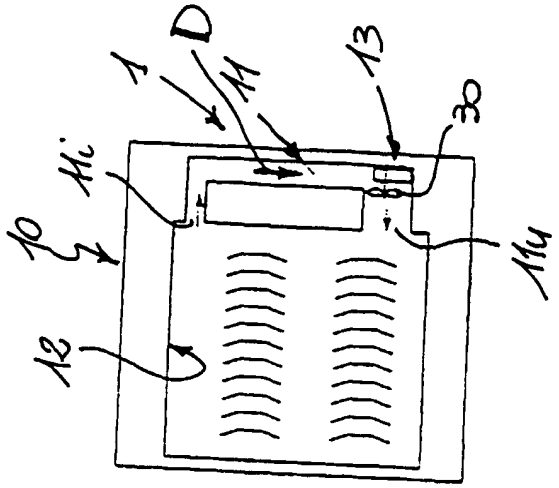

Fig. 1

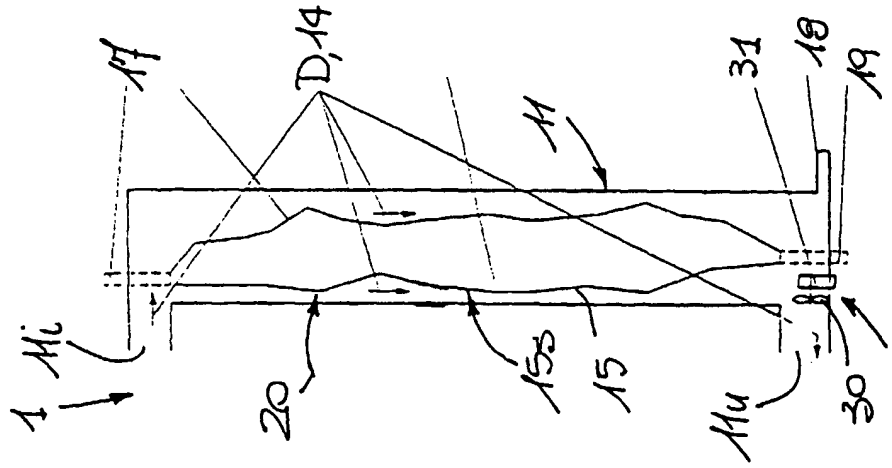

Fig. 3

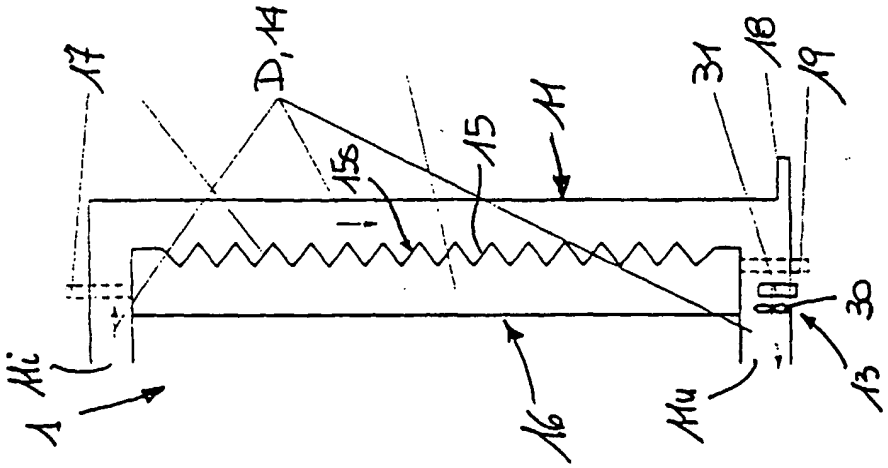

Fig. 2

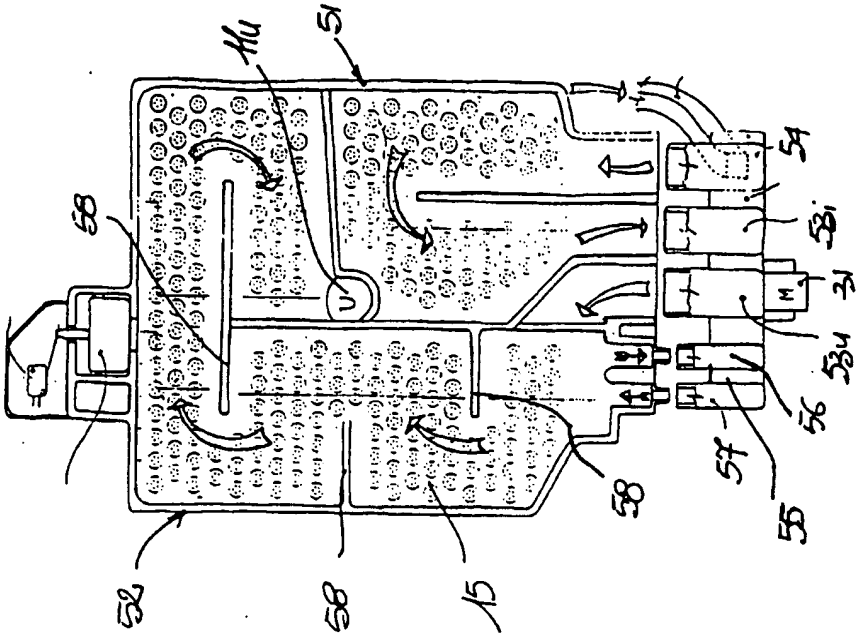

Fig. 4

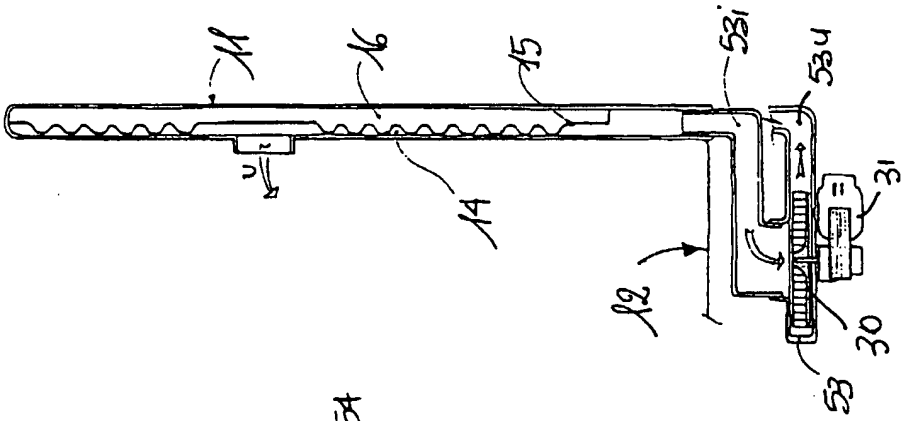

Fig. 6

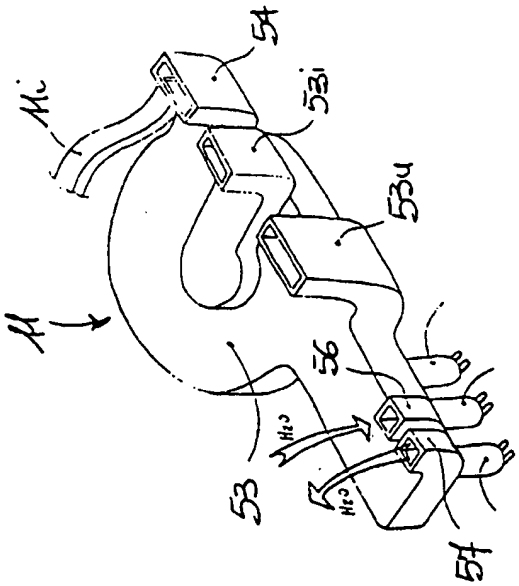

Fig. 5